GRAFACON

MODEL 1010

The GRAFACON* MODEL 1010 is a two-dimensional, digital graphic input system for general purpose computers. The system comprises a "writing" surface, stylus and associated control electronics. It permits greater freedom of expression in direct man-machine communication than heretofore possible.

The unique printed-circuit screen, with printed circuit capacitive-coupled encoding, is the heart of the graphic input system. The writing surface is a 10 x 10 inch area, with 100 lines per inch resolution in both x and y. It accommodates 10^6 input locations, with excellent linearity. A computer-controlled scanning system to locate and track the stylus is not required.

The stylus contains a pick-up probe, amplifier and a control-signal switch which is actuated by pressure on the stylus tip. System control electronics is completely solid state, and is contained in 7 inches of panel space for standard 19″ rack mounting.

The GRAFACON MODEL 1010 is the first all digital input system available for general man-machine communication. The system finds application in a wide range of fields now utilizing digital computers extensively as a means of research, production data processing, and graphical data reduction.
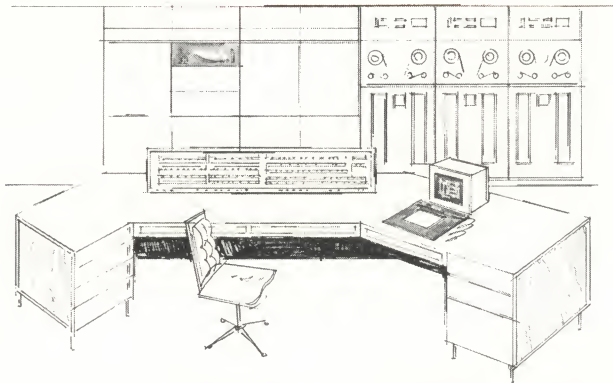
*TM Data Equipment Co.

DATA EQUIPMENT COMPANY
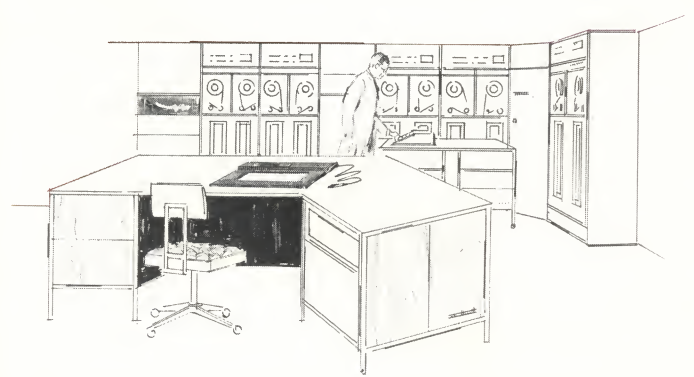
GRAFACON MODEL 1010 APPLICATIONS

Digital computer input device for application of graphical languages, automated design and planning functions.

For the **digitizing** of:

- **X-Y and strip chart recordings**
- **Meteorological and hydrographic charts and maps**
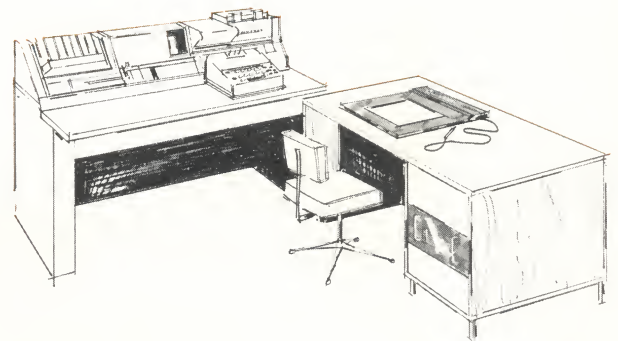- **Handwriting**
- **Aerial photographs**

On-Line . . . GRAFACON with Digital Computer

Off-Line . . . GRAFACON/Magnetic Tape System

Off-Line . . . GRAFACON/Paper Tape System

Off-Line . . . GRAFACON/Punched Card System

GRAFACON MODEL 1010 SYSTEM DESCRIPTION

Description of the GRAFACON MODEL 1010 is illustrated by reference to the general system block diagram. Information flow paths are indicated by the heavier lines. The Clock Sequencer furnishes a time sequence of 20 pulses to the blocking oscillators, during which they give coincident positive and negative pulses on two lines attached to the tablet.

The pulses are encoded by the tablet as serial x, y Gray-code position information which is sensed by the high-input-impedance, pen-like stylus from the epoxy-coated tablet surface. This information is strobed, converted from Gray to binary code, assembled in a shift register, and gated in parallel to an interface register.

The Gray code was selected so that only one bit would change value with each wire position, giving a complete and unambiguous determination of the stylus position. Further, Gray code facillitates serial conversion to binary.
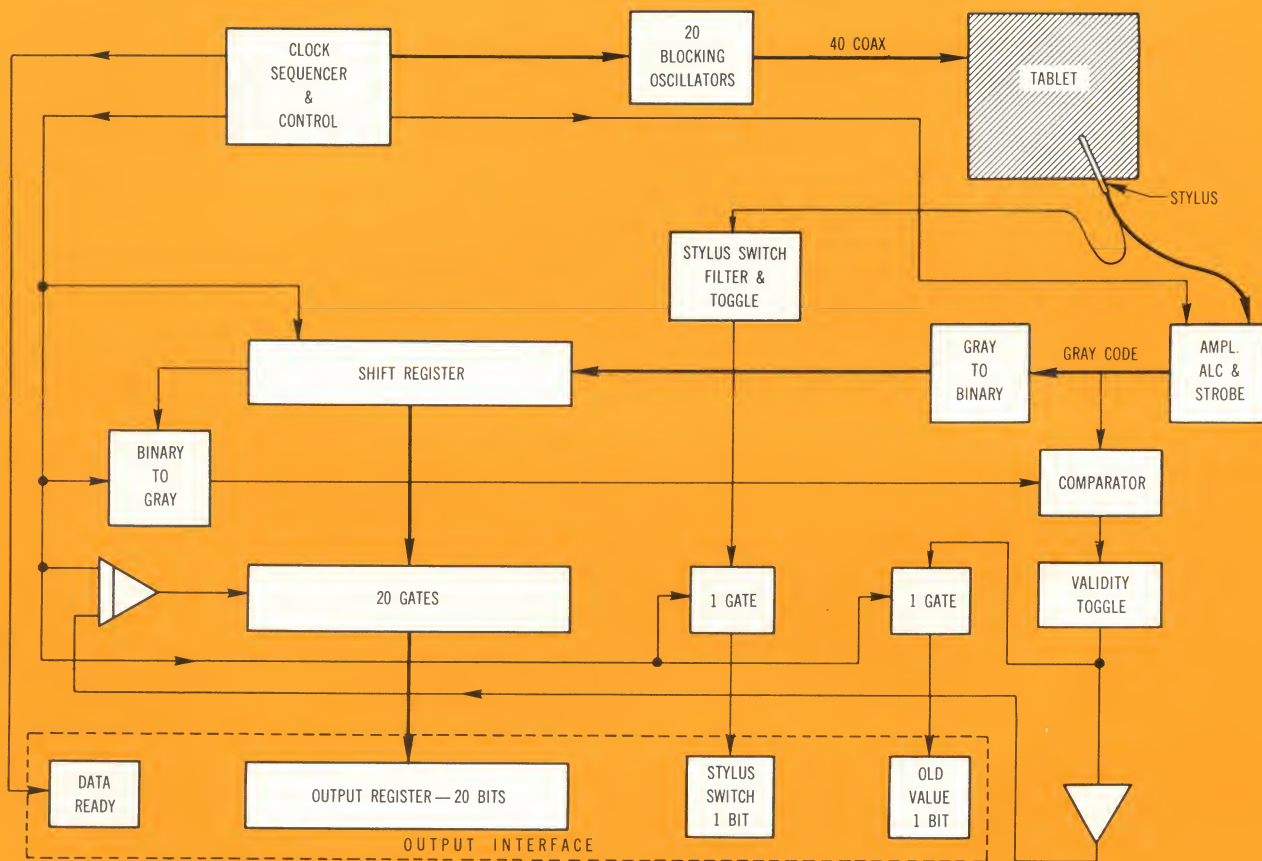
The printed-circuit, all digital tablet, complete with printed-circuit encoding, is a new concept, and is the heart of the graphic input system. The basic building material is 0.5-mil-thick Mylar sheet, clad on both sides with ½ ounce copper (approximately 0.6 mils thick) and etched. The result is a printed circuit on each side of the Mylar, each side in proper registration with the other.

The top circuit contains the x position lines and y encoder sections, while the bottom circuit has the y position lines and x encoder sections. Position lines are connected at the ends to wide, code-coupling buses; these buses are as wide as possible in order to obtain the maximum area, since the encoding method depends on capacitive coupling from the encoder sections through the Mylar to these buses. The position lines are alternately connected to wide buses on opposite ends, giving symmetry to the tablet and minimizing the effect of registration errors.

A pen-like stylus of high input impedance placed anywhere on the tablet will pick up a time sequence of pulses, indicating the x, y position of the stylus. This detected pulse pattern will repeat itself every major cycle as long as the stylus is held in this position.

As the stylus is moved, a different pulse pattern is sensed, indicating a new position. Since there are 1024 x position lines and 1024 y position lines, 20 bits are required to define a point.

CLOCK SEQUENCER & CONTROL — 20 BLOCKING OSCILLATORS — 40 COAX — TABLET — STYLUS — STYLUS SWITCH FILTER & TOGGLE — GRAY TO BINARY — GRAY CODE — AMPL. ALC & STROBE — SHIFT REGISTER — BINARY TO GRAY — COMPARATOR — 20 GATES — 1 GATE — 1 GATE — VALIDITY TOGGLE — DATA READY — OUTPUT REGISTER — 20 BITS — STYLUS SWITCH 1 BIT — OLD VALUE 1 BIT — OUTPUT INTERFACE

The final stages of the amplification and the strobing circuit are dc-coupled, and the system is thus vulnerable to shift in the dc signal level. An automatic level control (ALC) circuit has been provided to ensure maximum recognizability of signals. During the first 180 μsec of a major cycle, the stylus is picking up bits from the tablet. During the last 40 μsec, the tablet is at its quiescent level, and the quiescent level of the pen is strobed into the ALC toggle. In a perfectly balanced system, the ALC toggle alternates between 1 and 0 with each major cycle.

As an x, y value is being converted to binary and shifted into one end of the shift register, the old binary value is being shifted out the other end, serially reconverted to Gray and compared to the incoming Gray value, one bit at a time. If the old Gray number and incoming Gray number differ in more than one bit in either x or y, a "validity" toggle is set to indicate an error, that the pen has moved more than one line during the 220-μsec interval.

The logic and clock systems are made up principally with NOR circuits and univibrators. Transformer coupling ensures well-matched positive and negative pulses to obtain proper cancellation at the tablet surface.

DIMENSIONS
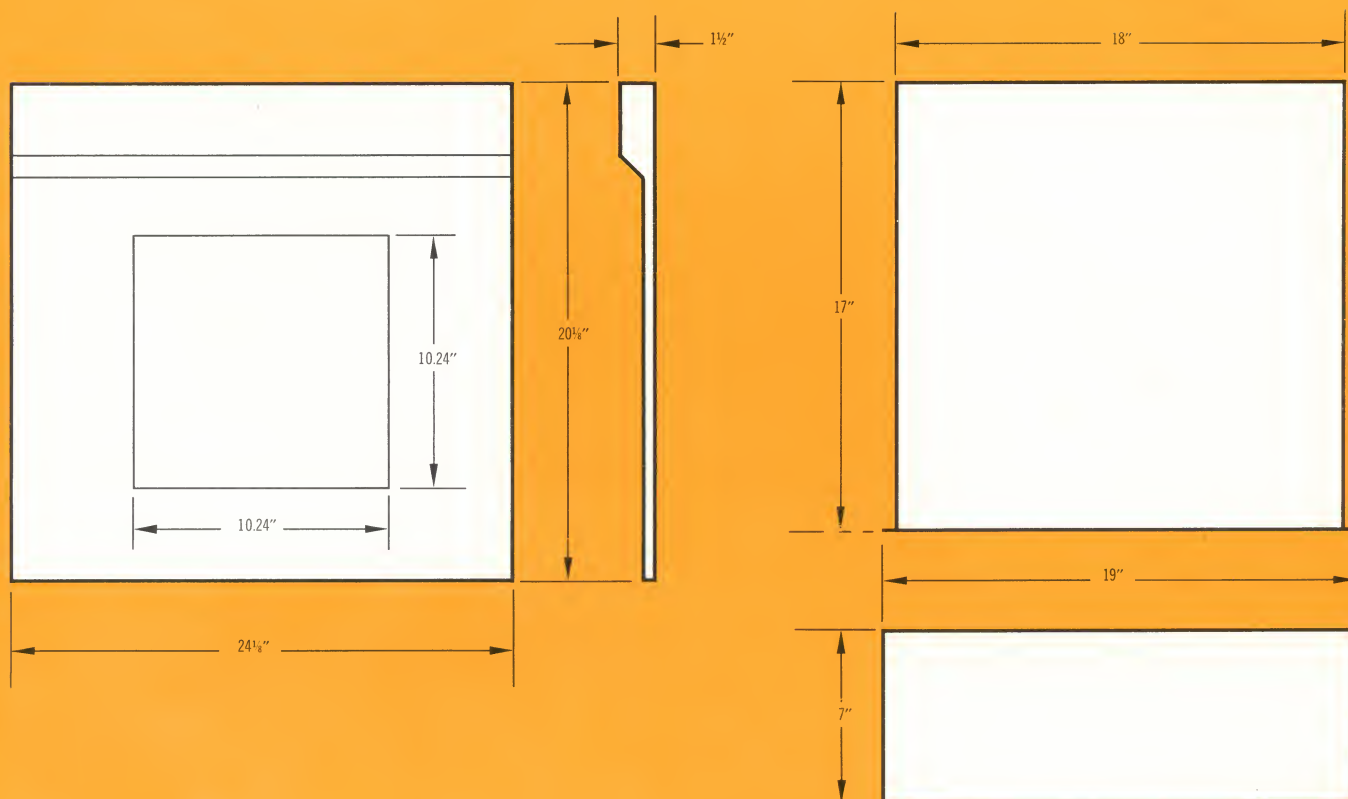
GRAFACON MODEL 1010 SPECIFICATIONS
ALL SOLID STATE CIRCUITRY

DATA RATE
4,500 points (X, Y) per second; 220 μsec. timing cycle duration

RESOLUTION
100 Lines per inch

OUTPUT INTERFACE DATA

OUTPUT REGISTER
Two, 10-bit, x and y
TOGGLE LEVELS
−.2v. to 0v = True or 1
−4v to −6v = False or 0

DATA READY TOGGLE
Set true 14 μsec. after completion of interrogation pulses; remains true 188 μsec.

STYLUS
Toggle reset (0) after pulse train from tablet; goes true (1) 9 μsec. later if switch is still actuated.

OLD VALUE TOGGLE
Validity toggle is set if the output register number differs by more than one bit from incoming value. If data held is invalid, register is left with previous value and old value toggle is set.

ELECTRICAL INTERCONNECTIONS
The toggle outputs (binary value and its complement) from the X and Y registers are made available through AMP 201299-1 connectors. Control signal toggle outputs are available through an Amphenol 57-40140. Both connectors are located at the rear of the electronic package. The connecting cables should be fabricated with RG/174 coax and may be up to twelve (12) feet in length.

TABLET CONNECTION TO ELECTRONICS
A twelve (12) foot cable fabricated with RG/174 coax is furnished.

ENVIRONMENT
Temperature range 0° to 50°C, relative humidity 85%.

POWER
105v to 125v, 50/60 cps., 40w.

DIMENSIONS
Tablet: Writing area − 10.24″ x 10.24″.
 Overall − 20⅛″ x 24⅛″ x 1½″
Electronics: 7″ x 18″ x 19″.

WEIGHT
Tablet: 7 pounds.
Electronics: 35 pounds.

Price: Model 1010 − $9,600.00 F.O.B. Santa Ana, Calif.; Terms, Net 30 days.
Prices and specifications subject to change without notice.

ON-LINE/OFF-LINE INTERFACE ELECTRONICS WILL BE QUOTED UPON REQUEST.

The GRAFACON Model 1010 is manufactured under license from the Rand Corporation, Santa Monica, California